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Wireless Industrial Parameter Monitoring Using Raspberry PI 3

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Abstract: **This paper proposes an advanced system for process management via a credit card sized single board computer called raspberry pi based multi parameter monitoring hardware system designed using that measures and controls various global parameters. The system comprises of a single master and slave with wireless mode of communication and a raspberry pi system that can either operate on windows or Linux operating system. The parameters that can be tracked are current, voltage, temperature & light intensity.**

The master board use raspberry Pi, LM35 & LDR Sensors, Water level sensor(IC CD4066) ZIGBEE and Wi-Fi . From slave board the data is sent to the master and from master the data is sent to personal computer. We can monitor the data through Personal computer, display device (16x2 LCD) and simultaneously we will get email alerts when the parameter readings exceed the limit.

Keywords: **Wireless Industrial Parameter Monitoring; Raspberry Pi 3; LDR Sensor; ZigBee Communication; Python Programming; Voltage; Temperature & Light Intensity.**

I. INTRODUCTION

Real time monitoring of power system is essential for its continuous and reliable operation. This advanced system presents a low cost, low power consuming system that can be used for quick and accurate power system parameter monitoring. The designed system will continuously measure the processes and display the power system parameters like voltage, current.

Now-a-days the accidents in the industries have increased. Even if any explosion occurs it can't be easily known to the laborers and it may cause accidents. So in order to avoid this, a system has been designed and this is allowed to monitor the ambient situations inside the industry. Some of the parameters such as explosions, temperature and water level are sensed by using sensors and the received data from sensors transmitted to the microprocessor used in raspberry PI and then transmitted to the personal computer through ZigBee module. By this the human intervention can be avoided inside the industry and the accidents can be prevented.

Wireless communication is very important concept and it plays an important role in various industries of automation field. Today the application of wireless communication in industrial automation is increasing rapidly. In some applications human beings have been replaced by unmanned devices that will acquire data and relay the data back to the base. A single person can monitor and even interact with the ongoing work from a single base station.

Wireless based industrial automation is a prime concern in our day-to-day life. The approach to Wireless Network for Industrial Applications standardized nowadays. Intelligent and low-cost automation of industrial processes are crucial in order to improve process efficiencies, deliver quality products, and ensure timeliness and accuracy of systems. Wireless is predicted to be one of the fastest growing technologies in the area of process automation sector. The embedded web server network consists of advanced processor ARM11-Raspberry Pi. It is having RISC architecture. An embedded web server creates an easy way for monitoring & controlling any device which is at remote place. For designing the system we require remote pc along with the internet facility at the remote locations. We implement a system which is portable, low cost & having less maintenance by using ZigBee technology. ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require Short-range low-rate wireless data transfer.

In the hazardous working environment, human safety is an important concern. At the same time if any person is absent in an important place for monitoring, it may also cause serious hazards. At present many systems are implemented in industrial areas but still accidents are occurring.

The new method is to design a system and that is place in industries. The system will be equipped with

some sensors like temperature and light for detecting the explosions and the ambient temperature. If any serious situation occurs means an alert given to the nearby workers.

Wireless communication is also an important issue inside the industry. Usage of wired technologies are not worthy as the cables will get damaged after a certain period of time or due to some environmental factors. So the wireless transmission technology is preferred. The industrial monitoring protocol should be designed such that the system must have a reliable end to end data delivery. The data which is collected from sensors should be transmitted without any delay and loss of data. Some of the techniques like ZigBee, Bluetooth, and Wi-Fi.

II. HARDWARE DESCRIPTION

A. Raspberry pi 3

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and developing countries. . Several generations of Raspberry Pi's have been released. The first generation (Pi 1) was released in February 2012 in basic model A and a higher specification model B. A+ and B+ models were released a year later. Raspberry Pi 2 model B was released in February 2015 and Raspberry Pi 3 model B in February 2016. These boards are priced between 20 and 35 US$. A cut down "compute" model was released in April 2014, and a Pi Zero with smaller size and limited input/output (I/O),general-purpose input/output (GPIO), abilities released in November 2015 for 5 US$.

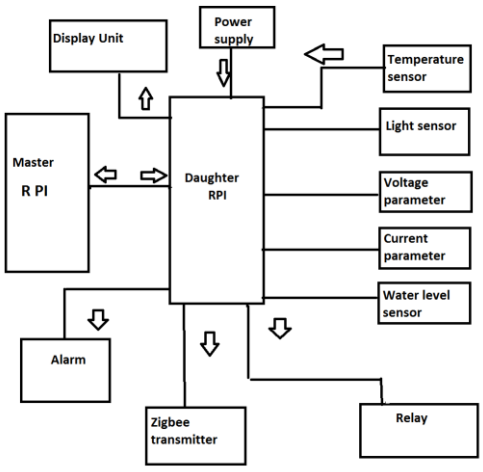
All models feature a Broadcom system on a chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on chip graphics processing unit (GPU, a Video Core IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. Secure Digital SD cards are used to store the operating system and program memory in either the SDHC or Micro SDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. Some models have an 8P8C Ethernet port and the Pi 3 has on board Wi-Fi 802.11n and Bluetooth.

The Foundation provides Debian and Arch Linux ARM distributions for download and promotes Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C,C++, PHP, Java, Perl, Ruby, Squeak Smalltalk, and more also available.

FEATURES OF RASPBERRY PI 3:

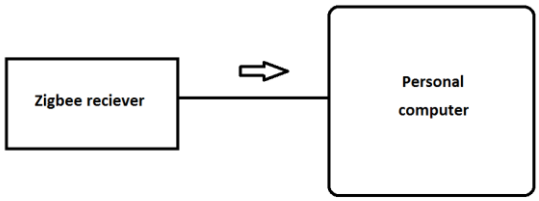
1. CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
2. GPU: 400MHz Video Core IV multimedia
3. Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
4. USB ports: 4
5. Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
6. Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
7. Peripherals: 17 GPIO plus specific functions, and HAT ID bus (Hardware Attached on Top)
8. Bluetooth: 4.1
9. Power source: 5 V via Micro USB or GPIO header
10. Size: 85.60mm × 56.5mm
11. Weight: 45g.

III. DESIGN AND IMPLEMENTATION



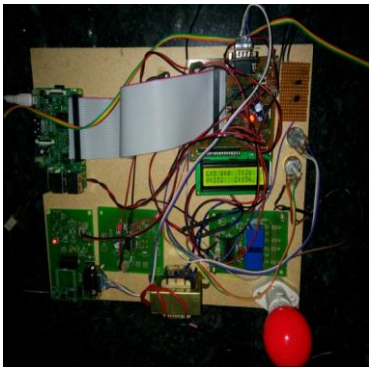
Block diagram of transmitter section

Daughter module is fully equipped with in built peripherals and bridging devices for communicating with raspberry pi or other platform. This module operates in 5 volts. Figure shows the interfacing of physical parameters like Temperature, Light intensity, Water level identifier, voltage and current in this module. Data acquired from each parameter is collected in daughter module is displayed in (16x2 LCD) which is connected to daughter module and sent to Master module through ZigBee transmitter. The relay and alarm are also connected for controlling purpose. The in-built analog to digital (ADC) converter is used to measure the voltage and current.

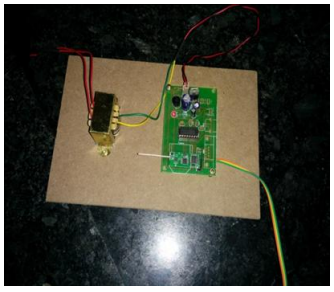


Block diagram of receiver section

In the above Figure the block diagram of the receiver section is given. In this section ZigBee receiver a personal computer can be used. Receiver collects the data from transmitter and send to the personal computer trough serial cable. We will get updates by every second and simultaneously an email alert given to the registered email ID when current, voltage and temperature exceeds the limit.



Transmitter section of proposed system



Receiver section of the proposed system

IV. RESULTS

In our proposed system we are using Raspberry pi 3 module which is having inbuilt wireless functionalities that support Wi-Fi and Bluetooth. We have used ZigBee wireless communication to wirelessly monitor all the parameters and using serial USB or wireless communication we can directly monitor the sensors and actuators through mobile or laptop computer by developing an application such that we can control and monitor various parameters and provide email alerts upon any voltage, current or water level fluctuations.

The screen shots of results obtained are as shown below:

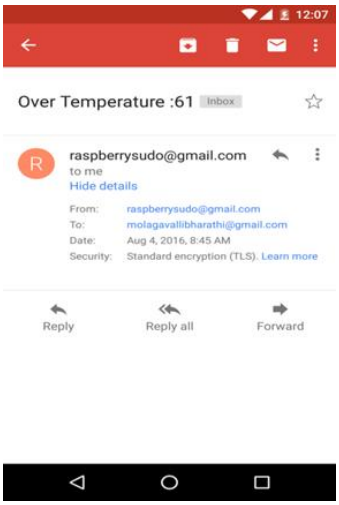


Figure of Temperature alert obtained after the temp rises above the limit value

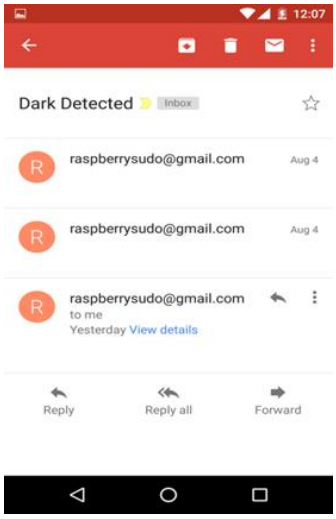


Figure of Light intensity alert when the LDR sensor detects decrease of brightness in the room

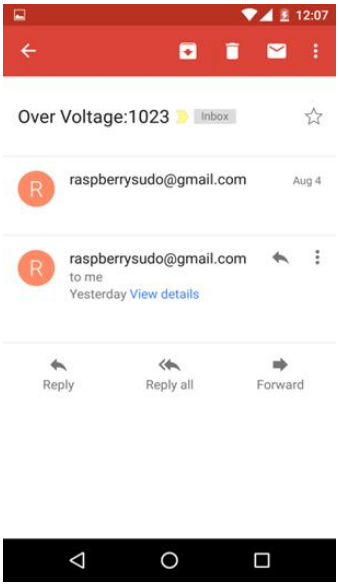


Figure of Voltage fluctuation alert through mail

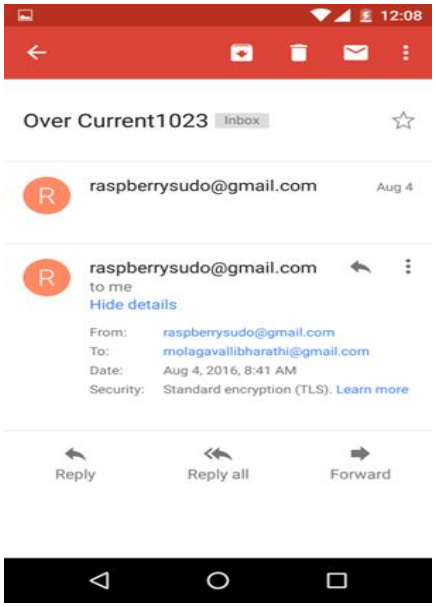


Figure of current fluctuation through mail

V. CONCLUSION

The designed robot is reliable to use and can be used in any working environment. The sensors which are used are so sensitive. The suffocation of the labors working inside the mine is avoided. The accidents are prevented which are caused by ambient conditions. This application can be used for all industrial area where human intervention for security can be avoided. In hospitals, shopping malls also this application can be used.

VI. FUTURE SCOPE

The system can be enhanced for wave form representation of data in an excel sheet using raspberry pi. The additional slaves can be added for measures various other parameters. Also controlling action can be set for some predefined cases in the master module which enables the automatic operation at certain cases. A dedicated video processor can be used in raspberry pi to display graphical and three dimensional view of the industry.

VII. REFERENCES

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